

## SUPPLEMENTARY MATERIAL

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### Dynamic analysis and experimental study of sweet potato seedling transplanting mechanism with non-circular gear system via ADAMS-EDEM co-simulation

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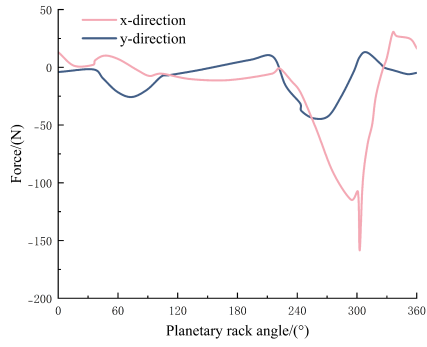
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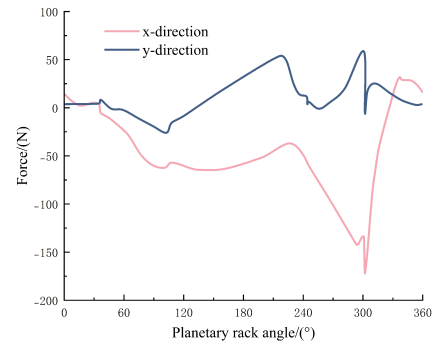
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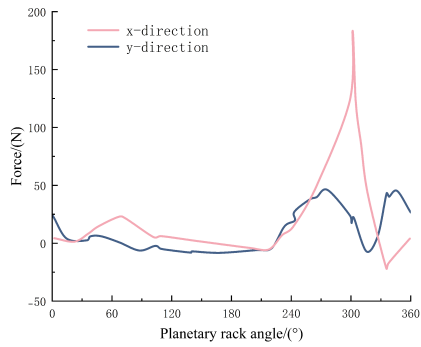
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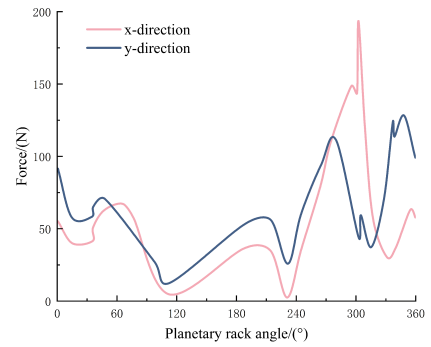
(a) Planetary - intermediate gear meshing force



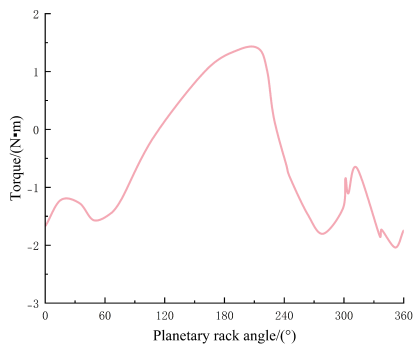
(b) Planetary gear rotation centre force



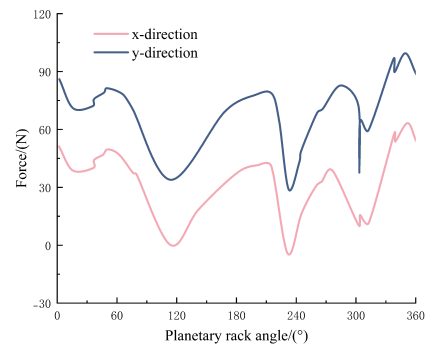
(c) Force applied to the centre of rotation of the intermediate gear



(d) Force acting on the rotation centre of the planetary carrier

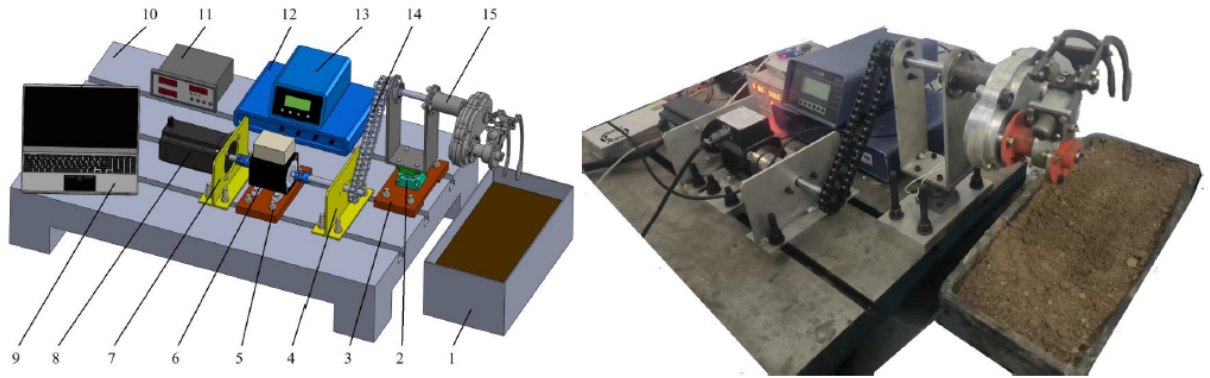


(e) Driving torque of the mechanism

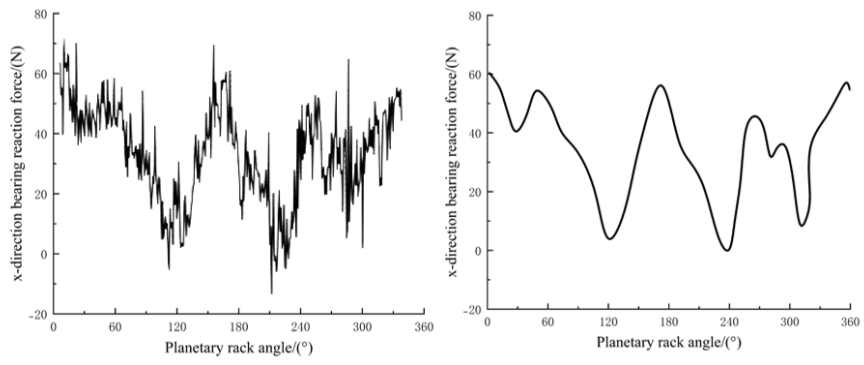


(f) Frame support reaction force

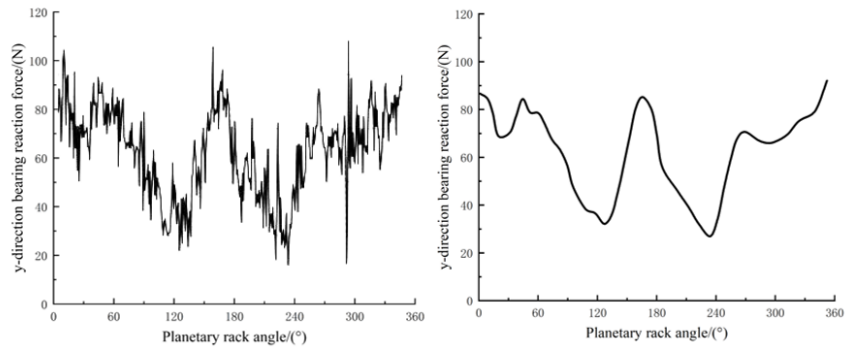
**Figure S1.** Results of the dynamic analysis of the planetary gear system of the transplanting mechanism.



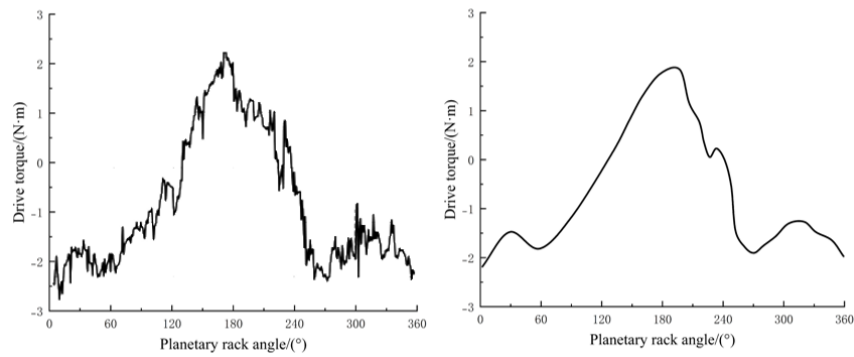
**Figure S2.** Transplanting mechanism dynamics test bench and its three-dimensional model. 1. Earthen trough. 2. Three-axis force sensor. 3. Force sensor pad. 4. Support. 5. Torque sensor pad. 6. Dynamic torque sensor. 7. Motor support. 8. Motor. 9. Computer. 10. Test bench base. 11. Dynamic torque measurement and control instrument. 12. Data acquisition instrument. 13. Signal amplifier. 14. Chain drive. 15. Transplanting.



(a) Filtered results of the reaction force test curve in the  $x$ -direction



(b) Filtered results of the reaction force test curve in the  $y$ -direction



(c) Filter processing results of driving torque test curves

**Figure S3.** Dynamic test results of the transplanting mechanism prototype.

**Table S1.** Related parameters for the soil.

Parameters	Numerical value	Parameters	Numerical value
Particle radius	3 mm	Static friction coefficient between particles	0.75
Density	2650 kg/m <sup>3</sup>	Particle-to-particle dynamic friction coefficient	0.15
Poisson's ratio	0.25	Intergranular recovery coefficient	0.65
Shear modulus	1.09×10 <sup>6</sup>		

**Table S2.** Soil simulation angle of repose under different surface energy parameters.

Surface energy parameter	0 J/m <sup>2</sup>	1.5 J/m <sup>2</sup>	3 J/m <sup>2</sup>
Simulated angle of repose	31.37°	41.62°	54.26°

**Table S3.** Comparison of institutional prototype dynamic test bench test results and theoretical analysis results.

Parameters	Driving torque/N·m		Reaction force in the <i>x</i> -direction/N		Reaction force in the <i>y</i> -direction/N	
	Theoretical value	Test value	Theoretical value	Test value	Theoretical value	Test value
Maximum value	1.43	2.10	63.52	78.19	99.82	112.86
Minimum value	-2.04	-2.42	-4.85	-11.71	27.59	28.70
Mean value	-0.52	-0.66	31.80	37.60	68.30	71.20
Variance/(N·m <sup>2</sup> )	1.24	1.47	237.90	300.30	261.20	293.10